

## ERYTHROCYTES AND HEMOGLOBIN IN THE BLOOD OF SOME AMERICAN BIRDS\*

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In Europe a number of records have been published giving the number of red corpuscles in the blood of birds. Stresemann ('27-34) states that in one cubic millimeter of avian blood there are from 1,500,000 to 5,500,000 red blood cells in contrast to 2,000,000 to 18,000,000 in mammals. He says that the number of erythrocytes within the same group varies in inverse proportion to the size of the birds, citing the following examples: Galliformes: European Quail (*Coturnix coturnix*) 4,000,000, Domestic Fowl 3,300,000, Turkey 2,300,000; Anseriformes: Australian Duck (*Anas superciliosa*) 2,800,000, Mute Swan (*Cygnus olor*) 2,150,000; Passeriformes: Waxbill (*Estrilda subflava*) 5,400,000, European Tree Sparrow (*Passer montanus*) 5,200,000, Raven (*Corvus corax*) 3,930,000.

Other records of interest are given by Ponder ('24): Carrion Crow (*Corvus corone*) 2,490,000 erythrocytes; Peregrine Falcon (*Falco peregrinus*) 2,547,000; Grey Heron (*Ardea cinerea*) 2,478,000; Spoonbill (*Platylea*) 3,400,000; White Stork (*Cinconia alba*) 2,189,000; Arabian Ostrich (*Struthio camelus*) 1,620,000.

Several studies have been made on the blood cells of domestic fowls and pigeons. Forkner ('29) reports twenty-nine counts on fowls ranging from 2,300,000 to 4,620,000 averaging 3,267,000. Landauer and David ('33) found that four cocks averaged 4,310,000 erythrocytes and five hens 3,395,000. As to pigeons, De Eds ('26-'27) found a median of 3,350,000 red blood cells in twenty-five birds. Kennedy and Climenko ('28-29) gave averages of 4,295,000 erythrocytes for five male and 3,563,000 for five female pigeons.

The most extensive and detailed work on the subject has been done by Riddle and Braucher ('34) who made 1,583 erythrocyte counts "throughout the year on suitably inbred races of the pigeon and the ring dove". Males showed higher erythrocyte counts at all seasons than females. "Mean values were 3,228,000 in males and 3,096,000 in females (pigeons); and 3,045,000 in males and 2,989,000 in females (doves)". "Highest erythrocyte counts were found in autumn, lowest in summer. In pigeons the autumn excess is 10 per cent; in doves 9.4 per cent."

Since no work of this nature seems to have been done on native American birds, we decided to determine the number of erythrocytes

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and amount of hemoglobin in some of the species which were being caught for banding purposes.

The subjects were taken to the laboratory in collecting cages covered with a dark cloth and kept for about an hour, so that they might recover from their excitement. A drop or two of blood was then obtained by puncturing a radial wing vein with a needle. The blood was drawn up to the .05 mark in a standardized pipette and diluted with eosin in Ringer Solution. After letting the blood in the pipette stand for some time and then carefully mixing it by shaking, the erythrocytes were counted on a double Neubauer ruled hemocytometer. In all cases double check counts were made, and in the event of disagreement, repetitions were made until they did check.

### RESULTS

A summary of our findings on eighty-six birds of sixteen species examined from October to May are shown in Table I.

It will be seen that the number of erythrocytes in the Passerine species averaged from 4,200,000 to 6,055,000; the lowest individual count being 3,930,000 (Tufted Titmouse), and the highest 7,645,000 (Junco). The median count of all the birds was 5,230,000 (Lincoln Sparrow). There is a wide range between the counts of individuals in the same species in some cases, yet with the exception of the single Towhee (a female) the average counts of the Fringillidae fall close together. The nine Song Sparrows gave somewhat lower results than the others. Among the other Passerines there is a wider range, but the representatives of each species are small in number. The three Tufted Titmice gave low counts and the three Cowbirds high counts.

As to the comparative size of these fifteen Passerine species, the smallest bird (Chipping Sparrow) weighed fourteen grams, while the heaviest (Grackle) weighed ninety-nine grams, seven times as much. The three heaviest of the Passerines (Grackle, Thrasher, and Cowbird) all have blood counts well above the median. There is no evidence from our results that there is an inverse relationship between size of bird and the number of erythrocytes. Probably this relation holds only with marked differences in size.

The three Bob-whites (all females) had a decidedly lower blood count than did the Passerines. This is in keeping with the findings of European workers.

We found no consistent difference between the counts in males and females. Perhaps larger numbers would have shown a difference. Neither did there appear to be differences between migrating and non-migrating birds. As to season, counts in the fall and winter with

TABLE I  
Average Number of Erythrocytes per Cubic Millimeter of Blood.

		M=Male. F=Female.	
PASSERIFORMES		RED BLOOD CORPUSCLES	
FRINGILLIDAE	Averages	Range	
28 White-throated Sparrows ..... ( <i>Zonotrichia albicollis</i> )	5272000	4010000	-6770000
18 Juncos ..... ( <i>Junco hyemalis</i> )	5567000	4495000 (F)	-7645000 (M)
9 Song Sparrows ..... ( <i>Melospiza melodia</i> )	4846000	4460000	-5225000
4 White-crowned Sparrows ..... ( <i>Zonotrichia leucophrys</i> )	5213000	4640000	-5690000
1 Tree Sparrow ..... ( <i>Spizella arborea</i> )	5610000		
1 Chipping Sparrow ..... ( <i>Spizella passerina</i> )	5530000		
1 Lincoln Sparrow ..... ( <i>Melospiza lincolni</i> )	5230000		
4 Cardinals ..... ( <i>Richmondia cardinalis</i> )	5123000	4488000 (M)	-5605000 (F)
1 Towhee ..... ( <i>Pipilo erythrophthalmus</i> )	4200000		
PLOCEIDAE			
6 House Sparrows ..... ( <i>Passer domesticus</i> )	5182000	4231000	-5769000
PARIDAE			
3 Tufted Titmice ..... ( <i>Baeolophus bicolor</i> )	4368000	3930000	-4685000
ICTERIDAE			
3 Cowbirds ..... ( <i>Molothrus ater</i> )	6055000	5420000 (F)	-6690000 (F)
1 Bronzed Grackle ..... ( <i>Quiscalus q. aeneus</i> )	5405000		
MIMIDAE			
1 Brown Thrasher ..... ( <i>Toxostoma rufum</i> )	5904000		
TURDIDAE			
1 Hermit Thrush ..... ( <i>Hylocichla guttata</i> )	4810000		
GALLIFORMES			
3 Bob-whites ..... ( <i>Colinus virginianus</i> )	3532000	3080000 (F)	-3805000 (F)

Juncos and Song Sparrows; in the winter and spring with Cardinals; and in the fall and spring with White-Throats, showed no consistent differences.

As to the hemoglobin content, Stresemann says that in birds it appears to be less than in mammals, "at least the dry substance of the erythrocytes in the goose consists of only 62.65 per cent of hemoglobin, in contrast to 94.3 per cent in man and 86 per cent in the dog (Hoppe-Seyler)". In comparison to these figures our hemoglobin results with the Sahli method were consistently higher. In White-Throated Sparrows in October and November it varied between 75 and 90 per cent, while with fifteen of the twenty cases it amounted to 80 per cent. In nine Juncos in the fall the counts ranged between 80 and 95 per cent, five cases amounting to 80 per cent. The Chipping Sparrow reached 75 per cent; five House Sparrows, three Song Sparrows, and a Hermit Thrush had 80 per cent, all taken in October. The three female Bobwhites varied more: one on October 31, 60 per cent, two, November 13, 80 and 100 per cent respectively. All birds were released a short time after a few drops of blood were secured from a radial wing vein for the erythrocyte and hemoglobin determinations.

In the later experiments the more accurate Newcomer method which gives the number of grams of hemoglobin per 100 c. c. of blood was used. Our results on seven species are shown in Table II. These figures are within the same range as found for human blood.

TABLE II  
Hemoglobin in Grams per 100 Cubic Centimeters of Blood.

Bird	Erythrocytes	Hemoglobin	Bird	Erythrocytes	Hemoglobin
White-throated Sparrow			Towhee		
April 26 .....	5,130,000	13.1	May 5 F.....	4,200,000	15.8
April 26 .....	5,395,000	13.9	Tufted Titmouse		
May 4 .....	4,425,000	13.2	December 9 .....	4,685,000	13.3
Junco			February 20 .....	4,490,000	13.6
December 8 M..	7,645,000	16.9	Bronzed Grackle		
December 9 M..	6,290,000	14.5	December 8 M..	5,405,000	16.5
December 9 M..	5,783,000	14.7	Brown Thrasher		
Cardinal			April 11 .....	5,904,000	16.0
December 15 F..	5,540,000	15.7			
February 6 M..	4,488,000	17.9			

Riddle and Braucher ('34) made 931 hemoglobin measurements on their pigeons and doves, and found that males of both species had a higher concentration at all seasons than the females. "Mean values were 15.97 grams in males and 14.72 grams in females (pigeons); and

14.56 grams in males and 13.97 grams in females (doves).” “Hemoglobin values were highest in winter—when the birds were exposed neither to air of greatest cooling power (autumn) nor to ultra-violet light. Lowest values were found in summer—when in air of least cooling power and well exposed to ultra-violet rays.”

#### SUMMARY

The number of erythrocytes per cubic millimeter of blood was determined in fifteen species of Passerine and one species of Gallinaceous birds.

The lowest number found for a Passerine bird was 3,930,000 in a Tufted Titmouse and the highest 7,645,000 in a Junco. The median of the eighty-three counts was 5,230,000.

The one Gallinaceous bird (the Bob-white) averaged 3,532,000

The hemoglobin in seven species of Passerine birds varied between 13.3 and 17.9 grams per 100 cubic centimeters of blood for a Titmouse and Cardinal respectively.

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